

# Agilent HCMS-29xx Series High Performance CMOS 5x7 Alphanumeric Displays

Reliability Data Sheet

### Description

The following cumulative test results have been obtained from testing performed at Agilent Technologies in accordance with the latest revision of MIL-STD-883.

Agilent tests parts at the absolute maximum rated conditions recommended for the device. The actual performance you obtain from Agilent parts depends on the electrical and environmental characteristics of your application but will probably be better than the performance outlined in Table 1.

The HCMS-29XX Series is a family of LED displays driven by onboard CMOS ICs. Each IC drives a group of four (5x7) characters.

The reliability data herein is based on an eight character display driven by two ICs. Failure rates of four and sixteen character displays can be assumed to be a multiple of the failure rate shown.

Table 1. Life Tests
Demonstrated Performance

					Point Typical Performance	
Test Name	Stress Test Conditions	Total Device Hrs.	Units Tested	Units Failed [3]	MTBF [1]	Failure Rate (% /1K Hours)
High Temperature Operating Life	$T_A = +85^{\circ}C,$ $V_{LOGIC} = 5.5 \text{ V}$ $V_{LED} = 5.5 \text{ V}$	473,048	484	7	67,578	1.480
Temperature Humidity Operating Life	T <sub>A</sub> = +85°C, RH = 85% Biased Static State V <sub>LOGIC</sub> = 5.5 V	490,000	500	12*	41,000	2.449

<sup>\*</sup> Some cracking on the edge of the device lens was experienced. These are considered cosmetic rejects only.

## **Failure Rate Prediction**

The failure rate of semiconductor devices is determined by the junction temperature of the device. The relationship between ambient temperature and actual junction temperature is given by the following:

$$T_J(^{\circ}C) = T_A(^{\circ}C) + \theta_{JA} P_{AVG}$$

where

 $T_A$  = ambient temperature in  $^{\circ}C$ 

 $\theta_{JA}$  = thermal resistance of junction-to-ambient in °C/watt

 $P_{AVG}$  = average power dissipated in watts

The estimated MTBF and failure rate at temperatures lower than the actual stress temperature can be determined by using an Arrhenius model for temperature acceleration. Results of such calculations are shown in the table on the following page using an activation energy of 0.43 eV (reference MIL-HDBK-217).



**Table 2. Reliability Predictions** 

		Point Typical Performance in Time [1] (60% Confidence)		Performance in Time <sup>[2]</sup> (90% Confidence)	
Ambient Temperature (°C)	Junction Temperature (°C)	MTBF [1]	Failure Rate (%/1K Hours)	MTBF [2]	Failure Rate (%/1K Hours)
85	138	68,000	1.480	40,000	2.488
75	128	91,000	1.093	54,000	1.838
65	118	126,000	0.795	75,000	1.337
55	108	176,000	0.569	105,000	0.957
45	98	250,000	0.400	149,000	0.672
35	88	363,000	0.275	216,000	0.463
25	78	538,000	0.186	320,000	0.312

#### Notes

#### **Example of Failure Rate Calculation**

Assume a device operating 8 hours/day, 5 days/week. The utilization factor, given 168 hours/week is:  $(8 \text{ hours/day}) \times (5 \text{ days/week}) / (168 \text{ hours/week}) = 0.25$ 

The point failure rate per year (8760 hours) at  $55^{\circ}$ C ambient temperature is:  $(0.569\% / 1 \text{K hours}) \times (0.25) \times (8760 \text{ hours/year}) = 1.246\% \text{ per year}$ 

Similarly, 90% confidence level failure rate per year at 55°C:  $(0.957\% / 1 \text{K hours}) \times (0.25) \times (8760 \text{ hours/year}) = 2.096\% \text{ per year}$ 

<sup>[1]</sup> The point typical MTBF (which represents 60% confidence level) is the total device hours divided by the number of failures.

<sup>[2]</sup> The 90% Confidence MTBF represents the minimum level of reliability performance which is expected from 90% of all samples. This confidence interval is based on the statistics of the distribution of failures. The assumed distribution of failures is exponential. This particular distribution is commonly used in describing useful life failures. Refer to MIL-STD-690B for details on this methodology.

<sup>[3]</sup> A failure is any LED which does not emit light, a mechanical failure or a parametric failure (device fails to meet published specification limits).

**Table 3. Environmental Tests** 

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
Temperature Shock	1011	-40 to +85°C, 32 cycles	36	0
Temperature Cycle	1010	-40 to +100°C, 100 cycles	869	1*
Power Temperature Cycle		-40 to +85°C, 15 minutes dwell/transfer, Power cycled 5 minutes on/off, 500 cycles	64	0
Solder Heat Resistance	Rel Monitor Program	+260°C, 5 ± 1 second, Two passes	1840	0

<sup>\*</sup> Some cracking on the edge of the device lens was experienced. These are considered cosmetic rejects only.

**Table 4. Mechanical Tests** 

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
Random Vibration	2026	10 to 2,000 Hz at 0.04 G <sup>2</sup> /Hz or 6 Gs RMS for 15 minutes /axis.	12	0
Mechanical Shock	2002	1/2 sine, 0.5 msec pulse, 5 blows each axis, 1500 g	22	0
Lead Integrity - Tension	2004 Condition A	0.9 Kgm for 10 seconds on all pins.	3	0
Lead Integrity - Bending Stress	2004 Condition B1	4 oz. for three 90° bends on each lead.	3	0

**Table 5. Electrical Tests** 

Test Name	MIL-STD-883C Reference	Test Conditions	Units Tested	Units Failed
ESD- Human Body Model	3015	100 pF, 1500 ohms, 2.0 KV at each polarity.	12	0

